DRAFT

"The attached draft information is provided as a tool for organizations developing their own means for evaluating medical waste treatment technologies. This information is provided only as a framework and is not for distribution and should not in any way be interpreted or represented as an official EPA document or test protocol."

STEAM AUTOCLAVE

DESCRIPTION: Steam autoclave treatment combines moisture, heat, and pressure to inactivate microorganisms. All steam autoclaves are constructed with a metal chamber to withstand the increased pressure/temperature. Autoclaves come in two basic varieties, gravity displacement and prevacuum autoclaves. The size of the devices may vary from benchtop models to large commercial models which can treat more than a ton of waste per cycle.

OPERATING PARAMETERS: The factors that affect the efficacy of steam autoclave treatment of medical waste are those affecting the internal waste load temperature, steam penetration of the waste, and the duration of treatment. These factors include:

- temperature and pressure achieved by the autoclave
- size of the waste load
- composition of the waste load
- steam penetration of the waste
- packaging of the waste for treatment
- orientation of the waste load within the autoclave

Steam autoclaves operate most effectively when the temperature measured at the center of the waste load approaches 121 °C and there is adequate steam penetration of the waste load under pressure.

WASTES SUITABLE FOR TREATMENT BY STEAM AUTOCLAVING: All wastes with the exceptions of body parts and contaminated animal carcasses which are excluded from treatment by steam autoclaving because the density of the waste items prevents adequate steam penetration. Radioactive, hazardous, and cytotoxic wastes are also inappropriate for treatment by steam autoclaving.

INDICATOR ORGANISMS: Thermally resistant indicator organisms are selected to provide a maximum challenge. *Bacillus subtilis* (globigii) ATCC 9372 (10^4) may be used to demonstrate a 4 $\log_{10}$ reduction of viable spores.

Bacillus stearothermophilus ATCC 12980 (10^6) may be used to demonstrate a 6 $\log_{10}$ reduction of viable spores.

TEST PROCEDURE: Dried test spores are placed in a thermally resistant and steam permeable container near the center of the waste load. The autoclave is operated under normal conditions. At the conclusion of the cycle the test organisms are removed from the load and recovered within 24 hours. To recover the test organism the test discs or strips should be aseptically inoculated into 5.0 mL soybean-casein digest broth medium (or equivalent) and incubated for at least 48 hours (30 °C for *B. subtilis* or 55 °C for *B. stearothermophilus*). At the end of the incubation period the media should be examined for turbidity as a sign of bacterial growth. Any growth should be subcultured onto appropriate media to confirm the identity of the organism as the indicator organism or an environmental contaminant.

DRAFT

"The attached draft information is provided as a tool for organizations developing their own means for evaluating medical waste treatment technologies. This information is provided only as a framework and is not for distribution and should not in any way be interpreted or represented as an official EPA document or test protocol."

CHEMICAL OR MECHANICAL/CHEMICAL TREATMENT

DESCRIPTION: A chemical disinfectant can be described as an agent which destroys disease causing or their harmful microorganisms. Disinfectant chemicals are registered under FIFRA by OPTS according to their use against particular types of pathogens. Disinfectants may be used alone or in combination with mechanical destruction devices or encapsulation agents.

OPERATING PARAMETERS: The effectiveness of treatment depends upon the characteristics of the disinfectant, the concentration of active ingredient, the contact time of the disinfectant with the waste, and the characteristics of the waste being disinfected.

WASTES SUITABLE FOR TREATMENT BY CHEMICAL DISINFECTION: Most medical waste items are suitable for treatment by chemical disinfection with the exceptions of body parts and contaminated animal carcasses which are excluded from treatment by chemical disinfection because of aesthetic reasons. Radioactive, hazardous, and cytotoxic wastes are also inappropriate for treatment by chemical disinfection.

INDICATOR ORGANISMS: Chemically resistant indicator organisms are selected to provide a maximum challenge. *Bacillus stearothermophilus* ATCC 12980 or ATCC 10149 (10^4) may be used to demonstrate a 4 $\log_{10}$ reduction of viable spores. These spores are not normally found in the medical waste stream, and can be recovered easily and are more selectively isolated due to their thermophilic growth requirements. Strains of *B. stearothermophilus* and *B. subtilis* have been shown to have essentially the same inactivation profiles from chemical exposure (Cole et al., 1991)

TEST PROCEDURE: A sufficient number of *B. stearothermophilus* spores must be added to the chemical treatment system to permit the recovery of enough organisms to demonstrate a reduction of at least 4 $\log_{10}$ of organisms in aliquot samples removed for recovery. Chemical systems are tested by comparing samples from the chemical treatment procedure with and without disinfectant. Spores are added to the system and liquid and solid samples collected at appropriate intervals after using either tap water or chemical disinfectant in the system.

The aliquot samples from the chemical treatment process should be neutralized immediately and the neutralized samples filtered and inoculated onto soybean-casein digest agar (or equivalent), streaked to quantify the samples, and incubated at 55 °C for at least 48 hours. At the end of the incubation period the organisms should be quantified to confirm that the appropriate level of spore reduction levels have been achieved. The samples collected from the chemically treatment procedure should demonstrate a 4 $\log_{10}$ reduction in the indicator spores in comparison to the tap water samples.

MICROWAVE IRRADIATION

DESCRIPTION: Large microwave irradiation medical waste treatment units include an initial destruction phase. The waste is automatically fed into a waste grinding device where it is shredded and sprayed with steam to increase the moisture content of the waste to approximately 10 percent. The moist ground waste is then heated by exposure to six microwave irradiation units over a 2 hour period. This process heats the waste to >90 °C.

OPERATING PARAMETERS: The factors which affect microwave treatment of medical waste include the frequency and wavelength of the irradiation, the duration of the exposure, destruction and moisture content of the waste material, process temperature, and the mixing of the waste during treatment.

WASTES SUITABLE FOR TREATMENT BY MICROWAVE IRRADIATION: Microwave treatment units can treat most infectious waste with the exception of cytotoxic, hazardous, or radioactive wastes. Contaminated animal carcasses, body parts, human organs, and large metal items may also be unsuitable for treatment by microwave irradiation.

INDICATOR ORGANISMS: Thermally resistant indicator organisms are selected to provide a maximum challenge. *Bacillus subtilis* (globigii) ATCC 9372 (10^4) may be used to demonstrate a 4 $\log_{10}$ reduction of viable spores.

TEST PROCEDURE: Dried test spores are placed in a steam permeable container and added to the waste stream after the waste is ground and sprayed with steam but before exposure to microwave irradiation. The microwave unit is operated under normal conditions. At the conclusion of the cycle the test organisms are removed from the waste and recovered within 24 hours. To recover the test organism the test discs or strips should be aseptically inoculated into 5.0 mL soybean-casein digest broth medium (or equivalent) and incubated for at least 48 hours (30 °C for *B. subtilis*). At the end of the incubation period the media should be examined for turbidity as a sign of bacterial growth. Any growth should be subcultured onto appropriate media to confirm the identity of the organism as the indicator organism or an environmental contaminant.

RADIOFREQUENCY IRRADIATION

DESCRIPTION: Large radiofrequency irradiation medical waste treatment units include an initial destruction phase. The waste is automatically fed into a waste grinding device where it is shredded and sprayed with steam to increase the moisture content of the waste to approximately 10 percent. The moist ground waste is then heated by exposure to radiofrequency irradiation. This process heats the waste to >90 °C.

OPERATING PARAMETERS: The factors which affect radiofrequency irradiation treatment of medical waste include the frequency and wavelength of the irradiation, the duration of the exposure, destruction and moisture content of the waste material, temperature achieved throughout the waste load during treatment, and waste storage duration.

WASTES SUITABLE FOR TREATMENT BY RADIOFREQUENCY IRRADIATION: Radiofrequency irradiation treatment units can treat most infectious waste with the exception of cytotoxic, hazardous, or radioactive wastes. Contaminated animal carcasses, body parts, human organs, and large metal items may also be unsuitable for treatment by RF irradiation.

INDICATOR ORGANISMS: Thermally resistant indicator organisms are selected to provide a maximum challenge. *Bacillus subtilis* (globigii) ATCC 9372 (10^4) may be used to demonstrate a 4 $\log_{10}$ reduction of viable spores.

TEST PROCEDURE: Dried test spores are placed in a steam permeable container and added to the waste containers after the waste is ground and sprayed with steam but before exposure to RF irradiation. The waste is moved through the RF unit which is operated under normal conditions. The waste containers are then stored for a period of approximately 4 hours prior to disposal. At the conclusion of the irradiation and storage cycle the test organisms are removed from the waste and recovered within 24 hours. To recover the test organism the test discs or strips should be aseptically inoculated into 5.0 mL soybean-casein digest broth medium (or equivalent) and incubated for at least 48 hours (30 °C for *B. subtilis*). At the end of the incubation period the media should be examined for turbidity as a sign of bacterial growth. Any growth should be subcultured onto appropriate media to confirm the identity of the organism as the indicator organism or an environmental contaminant.